Chaos is the Fraternal Twin of Creativity   by Charlie Stegemoeller

Have you ever walked into work one day thinking that you had a situation well in hand to be met with something far beyond your wildest imagination?

Something like this happened to me in the late summer of 1993. We were ready to implement the upcoming Space Life Sciences (SLS-2) Spacelab mission on the Shuttle. Crews were finishing training and preflight activities. Ground teams were readying for the conduct of the mission. Management was finalizing reviews to assure readiness for flight. We had done several Spacelab flights including a not-so-distant SLS-1 flight. At last it looked like Space Life Sciences research was on the "right"track. The entire team was well versed in the upcoming flight because the tasks, procedures, and approaches had all matured.

At the same time, a parallel universe was unfolding. The US had entered into a bi-lateral arrangement with Russia of flying a US astronaut on the Mir Orbital Station as well as establishing the working infrastructure in support of the emerging International Space Station reconfiguration. Our small science payloads management team had been tasked with initiating and developing the processes and techniques for interfacing with the Russian team for the integration of US research.

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We were made up of a young team of project leads and engineers that was used to the Space Shuttle/Spacelab processes. In fact, we had developed Systems Engineering tools that helped govern the team's success on previous Shuttle flights. But we were not experienced in Russian culture, technical styles and standards, and in approaches for long duration space flight.

As a single flight to Mir expanded to 10 flights, including expanded research objectives and outfitting Russian modules with 2000 kilograms of gear, none of us were ready for the chaos that erupted when we realized the extent of the work required to implement the Phase 1 Mir Research program on the schedule laid before us.

Now, try not to read too much into this ... it wasn't that we couldn't apply Systems Engineering practices, we just had never encountered them in this format.

For starters we had no translated or agreed upon process and requirements documentation to work from. Our hardware was still in fabrication. Our protocols for identifying scope were "in principal" at best and not fully laid out. We were also dealing with significant differences in culture and technical approaches for space flight.

Common sense dictated an implementation plan with schedules and templates and interdependencies. We tried, but each day was a new dawn. In some cases, several dawns occurred over a 24-hour period—nine time zones separated Houston from Moscow. Schedules obviously had to be written in pencil.

Most days, my desk was where I was standing – running. The key documentation that governed Russian standards for hardware acceptance and integration into the Mir were mistranslated. This fact was not fully understood until 3 months later and much closer to flight. The templates established for joint review of technical content were optimistic and unaware of the hidden time lags because of translation problems and failure to account for travel between the US and Russia.

None of our prior experiences prepared us for the Russian Acceptance Tests. The scope and purpose of the documents were laborious and unclear but still had

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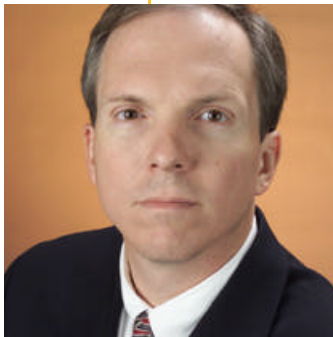
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to be reviewed in detail prior to physical testing. Testing standards were always subject to interpretation by the Russian representative. This was further exacerbated by the unstated, unavailable, and indeterminable electrical standards for grounding and electromagnetic interference.

All aspects of the tasks were challenging. Hardware that was previously approved for Shuttle flights had to be reworked, certified and accepted for use on Mir. Procedures for operating the devices had to be translated and then reworked to Russian standards and acceptance. Crew training approaches had to be realigned and ground processing of payloads occurred twice–once to US standards, once to Russian. The shipment of payloads had to endure temperatures from negative 50 to plus 50 degrees Celsius and shock loads of up to 20 g's as well as the ever evolving Russian Customs departments. None of these were US Shuttle standard experiences.

Negotiations and deliberations had to be conducted on both sides of the Atlantic using State Department processes for invitations, travel, and clearances, done of course with the use of translators and interpreters. And this was all happening at the same time we were learning to communicate, understand,and trust each other as to our respective intentions, motivations, and expectations.

And yet we made it! We conducted an impressively successful research effort on Mir, and without incurring any significant international incidents. How was this possible?

I believe that we were successful because the US and Russian teams quickly realized that success was the outcome we both sought. Despite all our other differences, we both held high standards for processing flight payloads for missions and believed that reaching an understanding of the payloads components and function was achievable. Despite all other differences, we both recognized that the value of collaboration in pursuit of our national objectives was a more productive approach than inflexibility in standards and approaches. And, despite often feeling like strangers in a strange land, our US team recognized that we were guests on their platform and thus had to put forward the good will required to get over so many procedural hurdles.

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As for the standard project practices, there were zealots on the US and Russian sides that demanded total compliance to pre-existing rules. Indeed we had to initiate calculated measures to stretch the letter of the rule to allow for innovation and forgiveness. Processes for hardware development required management teams on both sides to rethink their tactical perspective of "does it stay compliant with all previous required standards" to "how does this process aid this payload to successfully move through the system"; it required engineers to rethink their "solving problems via technical solutions first" to "knowing the counterpart socially then together tackling technical solutions together"; and, most of all, it required a great deal of flexibility in NASA management to allow choice regarding adherence to formal practices versus a requirement. Russian management teams also had to yield from rigid structures to flexible approaches to assure the intent of the agreed upon flight program to succeed.

Our team eventually saw the chaos we experienced as a gateway into a new and unknown environment. Through our deliberate efforts to explore and understand these new conditions, we found that chaos could be managed and remolded to accomplish the objective.

There were many other details, frustrations overcome, and challenges worked on the fly for the team and project to be successful. But we stayed focused on the end goal and chose to ride the wave we were on. So then, take a walk on the wild side of practice. You may never know what creativity you can forge out of chaos.

LESSONS LEARNED

1 In uncertain and changing situations the only way to win is to adopt a win-win approach.

2. Successful teams have long recognized that ongoing collaboration, based on recognition of mutual interdependence, is required in order to adapt easily to new requirements, respond quickly to frequent problems, and avoid conflicts.

QUESTION

Would you say that the lessons are applicable only to a few similar cases? Or, would you say that while the specifics of the situation differ from project to project, many underlying root causes that demand cooperation and adaptability are quite common?